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RUTILE-ILMENITE INTERGROWTHS

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The association of rutile and ilmenite as separate individuals is not unusual as a product of igneous rocks, of some pegmatites and certain high temperature veins, and of some contact metamorphic deposits. Mechanical mixtures of the two minerals, representing approximately simultaneous crystallization, have been less frequently recorded. This statement is limited to primary occurrences, and does not include alterations of the one mineral into the other.

One of the common alterations of rutile is to ilmenite, all stages in the process being observed in thin sections under the microscope. It becomes necessary, then, to distinguish between primary and secondary ilmenite, when it is found in intimate relations with rutile. Such differentiation is usually easy, except in those cases where alteration has advanced to the final stage in the process. No attempt, however, is made in this paper to formulate the criteria for distinguishing between primary and secondary ilmenite in association with rutile, since they are to be published in detail elsewhere.

Recent study by the writer of an interesting occurrence of rutile-ilmenite in a large quartz vein illustrates both primary intergrowths of ilmenite and rutile, and secondary ilmenite derived by alteration from rutile. Probably the secondary material is the greater in amount in the thin sections studied.

The vein is located in Franklin County, Virginia, less than one mile south of Roanoke River and one mile west of the entrance of Indian Creek into Roanoke River, and 15 miles southeast of Roanoke City. It has been prospected and considerable rutile is reported to have been obtained. The vein occurs in the crystalline schists of the western margin of the Piedmont Plateau province and about 8 miles east of the main Blue Ridge. Where crossed by the highway the vein has an elevation of 300 meters (1000 feet) above sea level. It appears not to exceed 15 meters (50 feet) in width, and is composed almost throughout of white granular sub-transparent crystalline quartz of remarkable purity. Locally, rutile and ilmenite occur, but they are the only other minerals observed in the vein.

The rutile and ilmenite are intimately associated, in clusters of crystals, both exhibiting their usual characteristic physical properties such as color, hardness, streak, etc. All crystals show the tetragonal-prismatic habit of rutile, without end faces. They measure up to 6½ cm. (2½ inches) long by 1 cm. (2/5 nch) broad. The prism faces are usually striated and furrowed. Twin crystals are rare.

Careful megascopic study of the material collected by the writer showed that some crystals were composed practically entirely of rutile, and some formless massive individuals entirely of ilmenite, but the bulk of the crystals presented a mixture of red-brown rutile and black ilmenite. This conclusion is confirmed by the microscopic study of thin sections, since not a single one of the many thin sections examined showed rutile free from admixture with ilmenite. In general the crystals exhibit: (1) primary intergrowths of the two minerals, and (2) alteration of rutile to ilmenite, in which the important stages in the process can be traced. In both cases the crystal form is that of rutile. Similar intergrowths of rutile and ilmenite, in formless masses, occurring in granite pegmatites in Virginia, have been described.[1] The primary intergrowths of the two titanium minerals have their analogy in the titaniferous magnetites, which are now well known to be magnetite containing mechanically entangled ilmenite.

In order to account for iron oxide present in analyses of rutile, Brögger and others[2] suggest that it be considered as the compound ferrous titanate [$Fe(TiO_3)$] in isomorphous mixture with titanyl titanate [$(TiO)(TiO_3)$]. This is based largely on theoretical grounds, since, however likely such relationships, Fe'' and (TiO)'' are assumed, and as Schaller states not yet proved, to be isomorphous. Holden[3] has shown that it is possible to calculate the specific gravity of this supposedly isomorphous constituent. It is interesting to note, however, that the value he obtained, 4.77, is essentially identical with those given in Dana's System for the purer forms of ilmenite.

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[1] Watson, Thomas L. and Taber, S.: *Bull. III-A, Va. Geol. Survey*, 248–258, especially Pl. XXXVI, Fig. 1, 1913.

[2] Schaller, W. T.: U. S. Geol. Survey, *Bull.* **509**, 9–39, 1912. (Includes references to Brögger, W. C., and Prior, G. T. and Zambonini, F., on isomorphous relationships of the rutile group.)

It seems to the writer unnecessary to assume isomorphism of rutile and a theoretical compound with the same chemical formula as ilmenite, not yet known to occur in nature. In the case here described there can be no question as to the presence of admixed ilmenite. The titaniferous magnetites offer a parallel case, ilmenite and magnetite not being isomorphous.[4]

Many supposed cases of isomorphism among sulfide minerals have been shown by critical study from modern viewpoints to represent mechanical mixtures.[5] The writer is convinced that this relationship also holds in many instances among opaque oxides.

TABLE I. ANALYSES OF RUTILE FROM VIRGINIA AND NORWAY

(William M. Thornton, Jr., Analyst)

	I	II	III	IV	V
TiO_2	97.30	80.85	98.80	95.71	97.68
SiO_2	.12	.06	.26	.92	1.06
Cr_2O_3	.05	.03	.07	.02	.39
V_2O_3	.26	.17	.20	.15	.55
FeO	2.21	18.81	1.68	2.35	.81
MnO	.09	.14	n. d.	Tr.	d. d.
H_2O	.10	.04	n. d.	n. d.	n. d.
	100.13	100.10	101.01	99.15	100.49
Sp. Gr.	4.272		4.21	4.196	4.225

I. Rutile from rutile-bearing quartz vein, Franklin County, Virginia.
II. Rutile-ilmenite from rutile-bearing quartz vein, Franklin County, Virginia.
III. Rutile from rutile nelsonite, Nelson County, Virginia.
IV. Rutile from rutile-bearing syenite, Nelson County, Virginia.
V. Rutile from rutile aplite (kragerite), Kragero, Norway.

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[3] Holden, Edw. F.: *Am. Min.*, **6**, 100–103, June, 1921.

[4] Warren, C. H.: *Am. Jour. Sci.*, **25**, 12–38, 1908; ibid., **33**, 263–277, 1912. *Econ. Geol.*, **13**, 419–446, 1918, and Singewald, J. T.: *Bull.* **13**, *U. S. Bureau of Mines*, 1913. *Econ. Geol.*, **8**, 207–214, 1913.

[5] Wherry, Edgar T.: *J. Wash. Acad. Sci.*, **10**, 488, 1920. Foshag, W. F.: *Am. J. Sci.*, **1**, 444-446, 1921.

It is well known that in the past chemists have not always been careful to insure homogeneity of the material analyzed. For this and other obvious reasons, microscopic study of the material to be analyzed should precede chemical analysis. Rutile which sometimes appears entirely fresh in hand specimens may show alteration in thin sections under the microscope. It seems not improbable, therefore, that the iron present in most analyses of rutile has been derived in part from secondary ilmenite.

Chemical analyses of the rutile and rutile-ilmenite from the Franklin County, Virginia, rutile-bearing quartz vein are given in columns I and II of Table I. There are also given in the table for comparison recent accurate analyses (III to V) of rutile from other well-known localities in Virginia and Norway.

The possible effect of the presence of Cr_2O_3 and V_2O_3 in rutile, as shown in all recent accurate analyses, has been discussed elsewhere by the writer.[6] Recasting the analyses in the table below by allotting FeO to TiO_2 to form ilmenite ($FeO.TiO_2$) the mineral composition in terms of rutile and ilmenite is:

TABLE II. MINERAL COMPOSITION BASED ON ANALYSES IN THE ABOVE TABLE
(Numbers correspond in the two tables.)

	I	II	III	IV	V
Rutile	94.80	59.92	96.96	93.04	96.80
Ilmenite	4.71	39.67	3.50	5.02	1.67
Rest	.62	.44	.53	1.09	2.00
	100.13	100.03	100.99	99.15	100.47

The analysis in column II clearly shows a mixture of rutile and ilmenite, in which rutile is in largest amount. Since the entire crystal yielding the results was used in the analysis and none remained for the preparation of a thin section for microscopic study, it is not possible to definitely state whether the ilmenite was primary or secondary or partly both. However, from microscopic study of thin sections cut from similar crystals, it is considered probable that the ilmenite was in part secondary, derived by alteration from rutile.

The writer's conclusion is that the iron shown to be present by analyses of rutile is derived from mechanically admixed ilmenite, and not from chemical mixture of a supposedly isomorphous iron compound.

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[6] Watson, Thomas L.: *J. Wash. Acad. Sci.*, 2, 431–434, Nov. 4, 1912.

CORUNDUM HILL (FRANKLIN), MACON COUNTY, NORTH CAROLINA

Samuel G. Gordon, *Academy of Natural Sciences of Philadelphia*

Visitors to the Vaux and Bement collections cannot have failed to notice the many fine ruby corundum crystals labeled Franklin, Macon County, North Carolina. Their source, the Cullasaja mine, was perhaps the most celebrated American corundum locality. This mine is to be numbered among those whose productiveness is of the past; inspiring the lament, that while new mineral localities are being discovered to take the place of the old ones, they are in such lands as Greenland or Africa—beyond the peregrinations of most mineralogists.

The Cullasaja mine is situated on a spur of the Cowee mountains, about one mile east of the place marked Cullasaja on the Cowee quadrangle, on the Cullasaja or Sugartown fork of the Little Tennessee River. The mines are about eight miles southeast of Franklin, the county-seat, and twenty miles distant from Sylva, the nearest railroad point to the north, on the Southern Railway. To one coming in from this direction, the opportunity is presented of seeing the well-known Webster dunite and websterite mass. An auto-bus service has been established between Sylva and Franklin.

Corundum Hill is a mass of dunite, exposed over an area of about ten acres, forming an intrusive body in mica schist. Large open cuts and rather barren dumps offer mute testimony of extensive operations in the past. Some of the more recent workings were by means of tunnels, while washing of the soil proved a profitable source of corundum. During the recent war, the mine had a new lease of life, and the writer was able to secure some well formed corundum crystals about the mill and one of the upper shafts.

Altho there were a number of more or less irregular corundum veins in the interior of the dunite mass, most of the open cuts follow the course of the "Big Vein" which was situated along the southern contact of dunite and gneiss.

Large boulders of dunite first meet the visitor's eye upon arriving at the locality, while the dumps yield attractive masses of broad-bladed, brownish anthophyllite, some talc, cullsageeite (a brown vermiculite), black tourmaline, and chlorite. About the upper shafts, corundum crystals may be found in boulders of disintegrating chlorite.

Aside from being a source of fine corundum crystals (a single one in the Shepard Collection at Amherst weighs 312 pounds), the deposit excited the attention of many early geologists, and its interest from a genetic point of view has not abated.

The corundum and peridotites of North Carolina have been described in detail in the admirable monograph of Pratt and Lewis.[1] The corundum veins consisted largely of chlorite and corundum, or locally of corundum-bearing plagioclase. In passing from an interior vein to the dunite, the following zones were encountered: 1. green chlorites; 2. grayish enstatite or anthophyllite, more probably the latter; 3. fibrous talc; 4. weathered dunite; and 5. normal dunite. Similar zones were found in the border veins.

Pratt and Lewis regarded the corundum deposits as magmatic segregations. However ingenious their theory, it may be regarded as untenable. The present writer[2] believes them to represent pegmatites intruded within or along the contact of the peridotite, and to owe their peculiar mineralogical composition to the reaction which occurred between the pegmatite solutions and the dunite, whereby the pegmatite was depleted of most of its silica, which was used in the formation of the chlorites and the minerals of the contact zones.

THE GEM MOUNTS OF THE AMERICAN MUSEUM OF NATURAL HISTORY

Herbert P. Whitlock, *American Museum of Natural History*

In the course of planning the installation of the Tiffany-Morgan Collection of gem stones, in the new Morgan Memorial Hall of the American Museum of Natural History, the problem of the effective display of cut gem stones was presented for solution.

In the former installation of this Collection the familiar type of wire mount, clamping the girdle of the stone, and terminating in a pin for fastening the mount upright on the horizontal background was used. This devise was open to criticism on several points. It permitted the display of too much metal, which materially detracted from the effective display of the stone, especially where many small stones were mounted in a close grouping. In this case the installation presented the appearance of a small forest of wires surmounted by the stones displayed, the latter being eclipsed by the preponderance of metal. Moreover the tightness of the clamp which held the stone in place formed a strong spring which tended to "shoot" the stone out of its mounting.

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[1] Joseph Hyde Pratt and J. Volney Lewis: Corundum and the peridotites of North Carolina. *N. C. Geol. Survey*, **1**, 1905.

[2] Desilicated granitic pegmatites. *Proc. Acad. Nat. Sci. Phila.*, 169–192, **1921**.

After some experimenting a group of seven types of *glass* mounts was devised to accommodate the display of gem stones ranging in weight from 500 to ½ carats. These were made, in the case of the five larger types, of thin glass rods cross braced, and remarkably strong for such fragile material. The two smaller types were constructed in the form of steep cones, and were even stronger to resist vertical pressure. In the instance of the four smaller types, the mounts ended in steel pins, to be driven into the wood of the supporting case bottom by a slight pressure, after the manner of a "push pin."

Because a certain amount of originality in the use of glass for this purpose is claimed for these supports, the writer takes this occasion to designate the series, a sketch of which is shown in Fig. I, as the "gem mounts of the American Museum of Natural History."

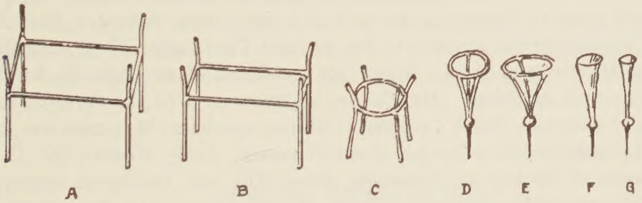

Fig. 1. Glass Gem Mounts of the American Museum

In all instances the stone is held in place by its weight alone; it was found to be unnecessary to attach it to the mount by any adhesive substance, such as Canada balsam, a distinct advantage, as the stone can be removed for test or comparison without disturbing the position of the mount in the case.

The chief advantage over the old form of gem mount, however, lies in the fact that the American Museum gem mounts are practically invisible. The stone so mounted has the appearance of floating in space above the supporting background, and it is necessary to examine them closely in order to detect the glass rods of the larger mounts or the tiny glass cones of the smaller ones.

This is in accordance with the idea which has been followed throughout the installation of the Morgan Memorial Hall, of emphasizing the specimens by rendering unobtrusive all the surroundings of them. Throughout the installation, cases, backgrounds, mounts and supports are merged into the general tone of the walls and ceiling, so that the eye is not diverted to unimportant accessories.

PROCEEDINGS OF SOCIETIES

PHILADELPHIA MINERALOGICAL SOCIETY

Academy of Natural Sciences, September 14, 1922

A stated meeting of the Philadelphia Mineralogical Society was held on the above date with the president, Mr. Trudell, in the chair. Nineteen members were present.

The following names were presented for membership in the society: Messrs. E. P. Wilkins, and James Henry Wilkinson. The following officers were nominated for the term 1922–1923; President, Mr. George Vaux, Jr.; Vice-President, Mr. Harry W. Trudell; Treasurer, Mr. Harry A. Warford; Secretary, Mr. Samuel G. Gordon.

Reports of summer trips constituted the program of the evening. Mr. Frederick Oldach gave an interesting account of a trip taken with Mrs. Oldach, and Messrs. Biernbaum and Hoadley to Bedford and Tilly Foster, N. Y., and Branchville and Middletown, Conn. Many fine specimens of rose quartz, beryl, and tourmaline were exhibited. Mr. Gordon reported on a trip to Avery, Mitchell, and Macon Counties, North Carolina, exhibiting specimens of transparent, bluish-green, aquamarine-like oligoclase from Plumtree, Avery County, N. C. Mr. Boyle spoke of his trip to Unionville, Beryl Hill, and Poorhouse quarry, with Messrs. Frankenfield, Chalfont, Knabe, Trudell, Jones, and Biernbaum. Mr. Biernbaum described a trip taken with Mr. Hoadley to the Harlem ship canal, Hoboken, and Snake Hill. Mr. Vanartsdalen reported finding excellent amphibole asbestus at Easton, Pa. Mr. Frankenfield gave an account of a trip to Cornwall, Pa., with Messrs. Boyle and Gordon, exhibiting a specimen of yellow barite crystals on calcite from that locality.

Mr. Horace Blank presented an interesting report of the Society's excursion, August 31 to September 5, to Branchville, East Hampton, and Middletown, Connecticut, which was participated in by the following nine members: Messrs.

Boyle, Blank, Biernbaum, Clay, Frankenfield, Gordon, Oldach, Knabe, and Trudell. At Branchville, albite crystals, beryl, margarodite, spodumene, and cymatolite were obtained; at East Hampton, golden beryl; at White Rocks, masses of pink and greenish tourmaline; at Strickland's quarry, green tourmaline, albite, beryl, and spodumene. The report was illustrated with lantern slides of photographs taken on the trip, and exhibits of specimens.

Mr. George Vaux, Jr. described a trip to Franklin, N. J. with Mr. Gordon, where some exceptionally fine specimens were obtained, including the following minerals: apatite, copper, rhodonite, datolite, willemite, glaucochroite, leucophoenicite, hancockite, wernerite, franklinite, and arsenopyrite.

Samuel G. Gordon, *Secretary*.

BOOK REVIEW

A LIST OF NEW CRYSTAL FORMS OF MINERALS. Herbert P. Whitlock. Bulletin of The American Museum of Natural History, Vol. xlvi, Art. II, pp. 89-278, *New York*, 1922.

In July 1910, the author published in *The School of Mines Quarterly*, (Vol. 31, No. 4 and Vol. 32, No. 1) a list of new crystal forms which had been recorded in the literature since the appearance of Goldschmidt's Index der Krystallformen der Mineralien (1886–91). The present bulletin includes the former data and extends the compilation to 1920, thus furnishing crystallographers with a most useful reference work covering a period of thirty years (1890–1920). References prior to 1890 being available in Goldschmidt's "Index."

Where a new orientation of a species has been proposed and accepted, forms previously cited have been transposed to correspond with the new axial elements. In such cases the elements used are given at the head of the species. Under each listed form is given, (a) the letter by which it was designated in the original paper, (b) the Goldschmidt indices, (c) the Miller indices, (d) the locality from which the crystals furnishing the form were derived, and (e) a number corresponding to an entry in a list of references placed at the end of each species, giving the author and publication containing the original description.

Workers engaged in crystallographic investigation will find this work extremely serviceable, as the literature in this field has become quite voluminous and the task of determining the status of an apparently new form, in some cases, almost impossible.

W. F. H.

NOTES AND NEWS

The British civil list pensions granted "in consideration of their circumstances" during the year ended March 31, 1922, includes the name of Lady Fletcher, in recognition of the services rendered to science by her late husband, Sir Lazarus Fletcher.

The Province of Quebec has purchased from the U. S. Radium Corporation one gram of radium, valued at $100,000, for the use of its citizens in the treatment of cancer and other malignant diseases. The radium will be sent to the University of Montreal, where, under the supervision of Dr. J. A. Gendreau, it will be at the service of the people of Quebec Province.

A letter recently received from Professor W. Vernadsky, the Russian mineralogist, states that he has been so fortunate as to make a trip to Paris and there become acquainted with the literature of mineralogy for the past six years. He will appreciate receiving reprints of articles issued during this period, and may be addressed care of the Museum d'Histoire Naturelle, Laboratoire de Mineralogie, Rue de Buffon 61, Paris, France.

We regret to note the death of O. Lehmann, the authority on molecular physics and liquid crystals.

A celebration in honor of the centenary of Louis Pasteur (1822–1895) is to be held at the American Museum of Natural History on December 27. At this meeting papers will be presented and crystals of tartrates and other compounds studied by Pasteur, exhibited.

At the Conference on World Metric Standardization which was held at the Carnegie Institute of Technology, simultaneously with the Pittsburgh meeting of the American Chemical Society, formal action was taken on four points, as follows: (1) *Voted*, that it is the sense of this meeting that we favor the gradual adoption of the metric system wherever practicable. (2) *Voted*, that this body take up with the United States Bureau of Education and other agencies, a plan for the better teaching of the metric system in the schools. (3) *Voted*, that the United States secretary of commerce be asked to secure information as to the extent to which the metric system is actually used at present in those countries which have made its use compulsory by law; and also in those countries where its use is not obligatory. (4) *Voted*, that the system of double-marking all goods be encouraged. (This vote was adopted by only a small majority.)

The Third Annual Meeting of the Mineralogical Society of America will be held on December 29, 1922, at Ann Arbor, Michigan. Fellows and members intending to present papers are urged to submit without delay the titles and brief abstracts to the Secretary, Herbert P. Whitlock, American Museum of Natural History, New York City.

NEW MINERALS: REDEFINITION OF SPECIES

FAMILY: OXIDES. DIVISION: COLLOIDAL $XRO : YR_2O_3 : ZH_2O$.

Heterogenite

A. Schoep: Sur la nature et la composition chimique d'un minéral de cobalt provenant du Katanga. (The nature and chemical composition of a cobalt mineral coming from Katanga). *Bull. soc. chim. Belgique*, **30**, 207–212, 1921.

Chemical properties: Average of several partial analyses gave: CuO 25.76, CoO 6.48, Co_2O_3 46.63, SiO_2 2.42, CO_2 4.27, H_2O 15.28, sum 100.84%. The SiO_2 is present as chrysocolla and the CO_2 as malachite, and after removing these constituents together with the corresponding amounts of CuO, the composition becomes: CuO 10.11, CoO 9.03, Co_2O_3 64.93, H_2O 15.93, sum 100.00% which corresponds approximately to $CuO.CoO.3Co_2O_3.7H_2O$. The mineral dissolves readily in HCl, with evolution of chlorine. The solution gives tests for Cu and Co, but no Mn.

Physical properties: General aspect like anthracite and obviously colloidal in character. Color black; streak brownish black; Luster vitreous; fracture conchoidal; $H=3-4$; sp. gr. $=3.128$; refractive index greater than 1.75.

Occurrence: Found in the Etoile mine, Elizabethville, Katanga, Belgian Congo, filling cavities in malachite and chrysocolla.

Discussion: Two other similar minerals have been described, heterogenite Frenzel, 1872) and schulzenite (Maertens, 1896). The compositions assigned to these are decidedly different from that of the present mineral, but as all three are colloidal, variation is to be expected. It is therefore recommended that the prior name heterogenite be applied to *all cobalto-cobaltic hydroxides*, of varying purity.

E. T. W.

FAMILY: SULFATES. DIVISION: $R':R'':(SO_4)=2:1:2$.

Palmierite

A. Lacroix, 1907; redefined by Ferruccio Zambonini: Sur la palmiérite du Vésuve et les mineraux qui l'accompagnent. (The palmierite from Vesuvius and the accompanying minerals.) *Compt. rend.*, **172**, (23), 1419–1422, 1921.

Chemical properties: *Formula:* $(K,Na)_2O.PbO.2SO_3$ or $(K, Na)_2Pb(SO_4)_2$. That originally given was more complex but was based on analysis of small quantities of altered material; new analysis on artificially formed crystals agreeing in every respect gave: K_2O 17.53, Na_2O 1.31, PbO 47.48, SO_3 33.62, sum 99.94%, corresponding to the formula above given. The mineral is rapidly decomposed by H_2O.

Physical properties: Color white; luster somewhat pearly on the base, vitreous on other faces. Specific gravity 4.50.

Crystallographic and optical properties: System rhombohedral, with $a:c=1:3.761$. Forms (0001), $(10\bar{1}0)$, $(10\bar{1}5)$, $(10\bar{1}3)$, $(10\bar{1}2)$, $(10\bar{1}1)$, and $(01\bar{1}2)$. $\rho_{1011}=77°2'$. Close to but quite distinct from aphthitalite. Optically uniaxial, $-$, with $\omega=1.712$.

Occurrence: Recently formed in the lava of a small cone in the bottom of the crater of Vesuvius. In various specimens it is associated with aphthitalite, Cu-Pb-bearing aphthitalite, ferronatrite, hematite, jarosite (new to Vesuvius) and "euchlorine."

Discussion: The futility of basing highly complex formulas on analysis of minute amounts of a mineral of doubtful purity is again illustrated; union of oxides in other than very simple integral proportions should only be regarded as demonstrated when there is convergence of a considerable number of analytical results or other lines of evidence.

E. T. W.

FAMILY: SILICATES. DIVISION: $R''':R''''=1:1$.

Thortveitite

Jakob Schetelig: Thortveitite, a new mineral. *Centr. Min. Geol.*, **1911**, 721. Redefined by the same: Thortveitite, a silicate of scandium, $(Sc,Y)_2Si_2O_7$. *Norsk Geol. Tidsskr.*, **6**, 233–244, 1922.

Chemical properties: *Formula*, essentially $(Sc,Y)_2O_3:2SiO_2$ or $(Sc, Y)_2Si_2O_7$. Somewhat approximate analyses gave as follows: I. by Schetelig, SiO_2 42.9, Sc_2O_3

37.6, $(Y, Dy, Er)_2O_3$ 17.7, Fe_2O_3 2.1, FeO 0.8, loss on ign. 0.4 sum 100.9%. II. By J. Sterba-Böhm, SiO_2 45.45, Sc_2O_3 42.06, $(Y, Dy, Er)_2O_3$ 8.89, Fe_2O_3 2.83, BeO 0.51, loss on ign. 0.54, sum 100.28%. The spectrum shows no B_e lines, indicating impurity or misinterpretation of some precipitate obtained in the second analysis. The material analyzed had been carefully hand picked in both cases. An incomplete analysis by Tauchert confirmed the figures of analysis I. The powdered mineral is partially decomposed by concd. HCl without gelatinization. On ignition its gray-green color changes to reddish white.

Crystallographic properties: System monoclinic. $a:b:c=0.7674:1:0.5569$, $\beta=77°28'$. Forms: $m(110)$, p.(111), $o(\bar{1}11)$, c (001), $u(\bar{1}31)$, and $v(\bar{1}41)$. Habit usually prismatic on m. Usually twinned with twinning axis normal to m, twinning and composition planes$=m$.

Optical properties: Biaxial, negative, with values for D: $\alpha=1.756$, $\beta=1.793$, $\gamma=1.809$, $\gamma-\alpha=0.053$. Plane of optic axes (010), $c:\alpha=5°$ in obtuse angle β. Axial angles $2V=65°\ 30'$ $2E=152°$. Pleochroic with $\alpha>\beta=\gamma$, with α deep green, β and γ brownish yellow, shown only in thick grains.

Physical properties: Color grayish green to black. Luster vitreous to subadamantine. Cleavage prismatic. Fracture uneven to conchoidal; very brittle. Hardness 6–7. Sp. gr. 3.57. No measurable radioactivity.

Occurrence: Has now been found at 4 localities in Saetersdalen, Norway, all in small granite-pegmatite dikes. The paragenetic succession in these is euxenite, monazite, alvite, ilmenorutile, thortveitite, beryl, magnetite, biotite, muscovite, oligoclase, microcline, quartz. One crystal observed was 35 cm. long and 4 cm. thick.

Discussion: Not closely related to any other known mineral. It is noteworthy that thortveitite seems always to be fresh, whereas many similar rare-earth minerals are usually altered into amorphous forms; this is suggested to be due to the lack of radioactive constituents. E. T. W.

DOUBTFUL SPECIES

FAMILY: PHOSPHATES, ETC. DIVISION: $R'':R'''''':R''''':H_2O=4:2:3:12$(?).

"Stasite"

Alfred Schoep: Sur las stasite, un minéral nouveau, dimorphe de la dewindtite. (Stasite, a new mineral dimorphous with dewindtite.) *Compt. rend.*, **174**, 875–977, 1922.

Name: In honor of the Belgian chemist, J. S. *Stas*.

Chemical properties: Appears to have the formula $4PbO:8UO_3:3P_2O_5:12H_2O$. The average of two fairly complete and several partial analyses made on material dried at 100° gave: PbO 25.86, CaO,MgO, traces, UO_3 56.02, P_2O_5 10.47, H_2O 5.60. Behavior similar to dewindtite.

Crystallographic and optical properties: Crystal system undetermined. Form, minute prisms, with square terminations. Elongation+. Refractive index >1.74.

Physical properties: Color golden yellow. Cleavage perfect in one direction. Sp. gr. 5.03.

Occurrence: Found admixed with the torbernite from Kasolo, Belgian Congo.

Discussion: The author considers this a dimorphous form of the compound previously described as dewindtite. The data presented hardly seems conclusive in establishing either the distinctness of the two, or the composition of the present one, and it is therefore classed as doubtful. E. T. W.

"Wodanite"

G. Lattermann: Investigations of the minerals of the Katzenbuckel, quoted by H. Rosenbusch, *Elemente der Gesteinslehre*, Ed. 3, p. 201, 1910; W. Freudenberg: Titanium-biotite (wodanite) from the Katzenbuckel. *Mitt. Bad. Geol. Landesanst.*, **8**, (2), 319–335, 1920.

Name: Origin unknown, as Lattermann's original manuscript was lost; presumably after the mythological character, *Wodan.*

Chemical properties: Four analyses are given, but they show wide variation; the following (by O. H. Heidenreich of Kristiania) is considered the most reliable SiO_2 38.69, TiO_2 12.56, Al_2O_3 9.45, Fe_2O_3 3.09, FeO 10.63, MnO 0.09, MgO 13.80, CaO (+traces of SrO and BaO) 0.83, K_2O 7.96, Na_2O 1.69, F 0.71, H_2O 0.76, sum 100.26%. It is concluded that the Ti is present largely as TiO_2 replacing SiO_2. From this a highly complex formula is derived.

Physical properties: Exhibits the features of biotite of the meroxene variety.

Occurrence: Found in the shonkinite rock of the Katzenbuckel, a famous German locality. C. S. Ross.

Discussion: The simple composition, corresponding as closely to the analysis as could be expected in view of the evident variability of the material, is: K_2O: $4(Mg, Fe)O$: $MgF(OH)$:$(Al, Fe)_2O_3$:Ti_2O_3:$6SiO_2$, an "orthosilicate" ratio; placing the Ti along with the Si makes the ratio too basic. It should be called tentatively *titaniferous biotite.* E. T. W.

FAMILY: COLUMBATES, ETC. DIVISION: $XR'':YR''':ZCb$, WITH $X>Z>Y$.

Unnamed

Yuji Shibata and Kenjiro Kimura: Chemical investigation of Japanese minerals containing rare elements. IV. Samarskite and an unnamed mineral from Ishikawa, Iwaki Province. *J. Chem. Soc. Japan*, **43**, 301–312, 1922; thru *Chem. Abstr.*, **16**, 2750, 1922.

Chemical properties: A preliminary analysis gave: MgO 1.07, CaO 0.86, MnO 0.40, FeO 11.78, Al_2O_3 0.87, rare earths 8.40, UO_2 21.88, SnO_2 1.20, SiO_2 0.30, TiO_2 0.21, $Cb_2O_5$36.80, Ta_2O_5 15.00, H_2O 0.89, sum 99.66%. This seems to correspond to $10\ R''O.R'''_2O_3.6\ (Cb, Ta)_2O_5$, where R'' includes (UO_2).

Physical properties: Color black; luster brilliant; opaque; H. = 5–6; sp. gr. = 6.2 – 6.4.

Discussion: Thought to be different in properties from the minerals of the samarskite group, but assignment of a name is withheld until a final analysis is made. Up to the present time at least two names, "nohlite" and "ånneroedite," have been given to material not essentially different in composition from that noted above. E. T. W.

ABSTRACTS—CRYSTALLOGRAPHY

THE STRUCTURE AND SYMMETRY OF ANATASE, RUTILE, ZIRCON, AND XENOTIME. A. Johnsen. *Centr. Min. Geol.*, **1919**, 97–105.

According to Johnsen, anatase, rutile, and xenotime are ditetragonal bipyramidal, while zircon is either ditetragonal or tetragonal pyramidal.

Edw. F. Holden.

CRYSTALLOGRAPHIC PROPERTIES OF THE COMPOUND $C_{11}H_7O_2N$

A. Johnsen *Centr. Min. Geol.*, **1919**, 33–34.

This compound is monoclinic, holohedral, $a:b:c=1.335\pm.003:1:0.57\pm.06$, $\beta=114°18\frac{1}{2}'\pm6'$; cleavage good (100), fair (101); sp. gr. $=1.345\pm.002$, at 16°; Z parallel to (010), Y to (001), X perpendicular to (100), X is acute bisectrix, 2E large, $\rho>\nu$ $\beta_{na}=1.756\pm.001$, pleochroic. E. F. H

THE INTIMATE STRUCTURE OF ISOMORPHOUS SUBSTANCES.

F. Rinne. *Centr. Min. Geol.*, **1919**, 161–172.

R. concludes that isomorphous substances have a structure intermediate between chemical compounds and physical mixtures. E. F. H.

THE CHANGE IN THE INTERFERENCE COLORS OF CRYSTALS, IN PLANE POLARIZED LIGHT, CAUSED BY TURNING THE NICOLS.

Alfred Wenzel. *Centr. Min. Geol.*, **1919**, 232–247.

Quartz and tourmaline especially are discussed, and formulas are derived.

E. F. H.

LAUE DIAGRAMS OF BENITOITE.

F. Rinne. *Centr. Min. Geol.*, **1919**, 193–201.

Benitoite is shown to be ditrigonal bipyramidal. E. F. H.

THE CRYSTALLOGRAPHY OF VOGTITE, AN ANORTHIC METASILICATE OF IRON, CALCIUM, MANGANESE, AND MAGNESIUM, FROM ACID STEEL-FURNACE SLAGS.

A. F. Hallimond. *Min. Mag.*, **18**, 368-373, 1919.

The slags were for the most part melts consisting principally of the three oxides FeO, MnO, and SiO_2, and yielded fayalite and rhodonite. The small amount of calcium silicate usually present is held in isomorphous solid solution, but when the amount of lime exceeds 8% a new silicate appears, which does not seem to belong to any of the known mineral groups. A summary of its properties are:

Name: Vogtite, in honor of J. H. L. *Vogt.* (This name was first proposed by C. Hlawatsch in 1907 to describe a substance either identical or at least isomorphous with the present material.)

Crystallographic Properties: Elongated crystals, triclinic system. $a:b:c=1.093:1:0.729$. $\alpha=99°37'$, $\beta=99°21'$, $\gamma=83°53'$. Forms: (010), (110), $(1\bar{1}0)$, $(0\bar{1}1)$, (101), $(3\bar{1}0)$.

Optical Proferties: Color, transparent and pale amber. Little or no pleochroism and nearly straight extinction. Axial plane is nearly $\perp$ to zone of elongation. Sign $-$. $\beta=1.701$. $\gamma-\alpha=0.018$. $2V=65\frac{1}{2}°$. Prismatic cleavage.

Chemical Properties: Composition approximates the metasilicate ratio; the deviation is greater than would be expected for the material analyzed, but is explained by solid solution of non-isomorphous compounds. W. F. H

OBSERVATION OF INTERFERENCE FIGURES ON CRYSTAL PLATES IN CONVERGENT POLARIZED LIGHT WITH AN α-MONOBROMNAPTHALENE CONDENSER.

Arthur Ehringhaus. *Neues Jahrb. Min. Geol.*, **1919**, I, 1-4.

A condenser with a numerical aperture of 1.55, to be used in conjunction with a microscopic objective of numerical aperture 1.52, is described. The upper lens of the three lens condenser has a refractive index of 1.66 which is the same as that of the immersing liquid, α-monobromnapthalene. This lens system is particularly valuable for observation of interference figures. The condition that both optic axes appear in the field in sections cut perpendicular to a bisectrix is given by: b. sin. $a < A$, where b = mean refractive index of crystal, $a = \frac{1}{2}$ optic axial angle, A = numerical aperture. A plate accompanying the paper shows among other things a section of anhydrite cut perpendicular to the obtuse bisectrix, both axes appearing in the field; the optic axial angle represented is 136° 19′.

O. von Schlichten.

THE LAUE PHOTODIAGRAM OF ICE. R. Gross. *Centr. Min. Geol.*, **1919**, 201-207.

Laue diagrams of ice place it in the dihexagonal bipyramidal class. E. F. H.

SEMSEYITE FROM DUMFRIESSHIRE. G. F. Herbert Smith; CHEMICAL ANALYSIS, G. T. Prior. *Min. Mag.*, **18**, 354-360, 1919.

The crystals examined were small and associated with stibnite, valentinite, ankerite, calcite, sphalerite and pyrite. Measurements were obtained by means of a 3-circle goniometer, and the values on two crystals are recorded. $a:b:c =$ 1.1356: 1: 1.0218. $\beta = 105°46'$. These data do not agree very closely with those previously published, which were obtained on crystals from Felsöbanya. The forms observed are: (100), (001), (201), $(\bar{2}01)$, (310), (021), (041), (223), (111), (221), (112), $(\bar{1}11)$, $(\bar{1}12)$, $(\bar{4}49)$, $(\bar{3}31)$. The faces $(\overline{18}.18.19)$ and $(\bar{5}56)$ are probably vicinal, and do not represent distinct forms. The material for the analysis was obtained from the drusy lining of one of the small cavities. The analysis checks closely with that required by the formula, $9\ PbS.\ 4\ Sb_2S_3$. W. F. H.

FELDSPAR CRYSTALS DEVELOPED IN THE UPPER CRETACEOUS PYRENEAN LIMESTONES. J. de Lapparent, *Compt. Rend.*, **167**, 784-6, 1918; thru *Min. Abst.* **1**, 276.

Small albite crystals are associated with foraminifera and algal remains. The author believes the algae have been responsible for the formation of albite.

E. F. H.

LAUE DIAGRAMS OF NEPHELITE. F. Rinne. *Centr. Min. Geol.*, **1919**, 129-133.

The Laue diagrams of nephelite agree with the etch figures in placing it in the hexagonal pyramidal class. E. F. H.

MINERALOGY

OUTLINES OF A SYSTEMATIC ARRANGEMENT OF "FIGURATIVE" ROCK OBJECTS. A. Issel. *Mem. Accad. Lincei*, [5], **11** (11), 41 pp., 1916; thru *Rev. géol.*, **1** (11), 426-427, 1920.

The objects discussed include concretions, geodes, stalactites, etc. E. T. W.

BIOLITES AND PISOLITES. A. Issel. *Noll. Comit. Geol.*, [5], **6** (4), 47 pp., 1916–1918; thru *Rev. géol.*, **1** (11), 427-428, 1920.

Comprises descriptions of various nodules and concretions. E. T. W.

ANDESINE FROM HOHENSTEIN IN THE KREMSTAL (LOWER AUSTRIA). O. Grosspietsch. *Sitz. Akad. Wiss. Wien, Math.-naturw. Kl.* Abt. 1, **127**, 439-47, 1918; thru *Min. Absts.*, **1**, 281.

An analysis of an andesine found in a pegmatite gave $Ab_{65}An_{35}$. Sp. gr. 2.67. Extinction on (001) about 0°, on (010) -2° to -5°. 2V 93.2°, α 1.5447, β 1.5489, γ 1.5528 (Na). E. F. H.

THE PRODUCTION OF SILICA AND SILICEOUS LIMESTONES BY ALGAE OF THE GIRVANELLA GROUP. J. de Lapparent. *Compt. Rend.*, **167**, 999-1001, 1918; thru *Min. Absts.*, **1**, 276.

The transformation of foraminifera tests to chalcedony, and the production of fine chalcedony in certain limestones, is attributed to the action of algae.

E. F. H.

A STUDY OF CERTAIN MINERALS FROM COBALT, ONTARIO. H. V. Ellsworth. *Ont. Bur. Mines*, **25**, I, 200-43, 1916.

The following minerals were analyzed, examined in polished section and in some cases crystal measurements were made: argentite, galena, chalcocite, breithauptite, niccolite, cobaltite, smaltite, chloanthite, arsenopyrite, glaucodot, matildite, proustite, polybasite, scorodite, erythrite, and (new for Cobalt) löllingite, rammelsbergite, chalcocite, and symplesite. Intergrowths of minerals are the rule here rather than true isomorphous mixtures. The paragenesis of the deposit is given.

E. F. H.

TWINNING OF QUARTZ FROM BRAZIL AFTER ξ. R. Brauns. *Neues Jahrb. Min. Geol.*, **1919**, I, 29-49.

Three quartz crystals from Serra dos Cristaes in Goyaz, Brazil, twinned after ξ (11$\bar{2}$1) are described minutely, followed by a discussion and summary of previous observations on twinning according to this law. O. von Schlichten.

NEPHELIN-BEARING PEGMATITIC DYKES IN SEILAND. Adolf Hoel and J. Schetelig. *Festkrift, Amund Helland, Kristiana*, **1916**, 110-31; thru *Min. Absts.*, **1**, 282.

In Seiland, Finmarken, Norway there are three types of pegmatites, characterized respectively by calcite, nephelite, and corundum. The calcite type contains primary calcite, zircon, tourmaline, apatite, muscovite, biotite and albite; the albite is in large xls. with forms *b c m M f z p o y n x u*. E. F. H.

CHEMICAL RELATIONS OF KAOLINITE AT HIGH TEMPERATURES. J. Matějka. *Chem. Listy, Prague*, **13**, 164-6, 182-5, 1919; thru *Min. Absts.*, 1 287.

The solubility of kaolinite in boiling NaOH at temps. from 110° to 1100° is recorded. The water goes off at 500-600°, and various Al silicates are successively formed until at 1100° there remains only a mixture of sillimanite and cristobalite.

E. F. H.

MONOGRAPH OF THE QUARTZ FROM BOHEMIAN COUNTRIES. I. A. Ondřej. *Prague*, **1919**, 66 pp.; thru *Min. Absts.*, **1**, 289.

Quartz crystals from six localities are described. Eight new forms are noted: from Hořepník, (13.0.$\overline{13}$.6), (70$\bar{7}$3), (15.$\bar{2}$.$\overline{13}$.7), (16.$\bar{3}$.$\overline{13}$.4), ($\bar{4}$.19.$\overline{15}$.4), from Pisek (9.1.$\overline{10}$.6), from Marešov (7$\bar{1}$61), (9.1.$\overline{10}$.6). E. F. H.

CALCITE FROM LIBUŠÍN. Aug. Ondřej. *Rozpravy České Akad.*, class 2, **27**, no. 14, 5 pp., 1918; thru *Min. Absts.* **1**, 289.

Beautiful calcite crystals occur in veins traversing Algonkian spilites in the Janský coal mine. Two new vicinal forms are *o* (6.27.$\overline{33}$.10) and *p* (31.9 .$\overline{124}$.32).

E. F. H.

THE CRYSTAL FORM-SERIES OF TOPAZ. V. Rosicky. *Rozpravy České Akad.*, class 2, **25**, No. 22, 65 pp., 1916; thru *Min. Absts.*, **1**, 292

A tabulation of axial ratios and crystal forms, with a bibliography. In only a few cases can axial ratios be correlated with composition. E. F. H.

SUPPLEMENTS TO THE NOTES ON MORAVIAN MINERAL OCCURRENCES. B. Kučera. *Sborník Klubu Přírodovědeckého, Brno* **2**, 22-3, 1918; **3**, 71-3, 1920; thru *Min. Absts.*, **1**, 292.

Minerals new for Bohemia are: bismuth, valentinite, brookite, caledonite, olivenite, phillipsite. Many new localities for other minerals are recorded.

E. F. H.

CONTRIBUTION TO THE STUDY OF HYDROZINCITE. C. Perrier. *Atti. Soc. Ital. Sci. Nat.*, **54**, 188-222, 1916; thru *Min. Absts.*, **1**, 294.

Specimens from six European localities were analyzed and examined optically. Thin sections showed needles and spherulites in an isotropic base. The purest material (Buggerru), wholly crystalline, gave the formula, $2ZnCO_3.3Zn(OH)_2$, and dehydration expts. on artificial and natural material point to this as the formula.

E. F. H.

GRAPHIC DETERMINATION OF BOTH OPTIC AXES OF TRICLINIC CRYSTALS FROM THE EXTINCTION DIRECTION ON FIVE FACES. A. Johnsen. *Centr. Min. Geol.*, **1919**, 321-326.

A means of determining the optic axes using the stereographic projection.

W. F. Foshag.

CONTRIBUTION TO THE KNOWLEDGE OF THE URANIUM-MICAS. B. Stočes. *Rozpravy České Akad.*, **27**, No. 27, 4 pp., 1918; thru *Min. Absts.* **1**, 291.

A new locality for torbernite is at Německá Lhota near Pribram, Bohemia. The following values were given: autunite, Joachimsthal n (mean) 1.596, 2E 45°; torbernite, Joachimsthal 1.628 and 20°, Schönficht, 1.610 and 25°, Schlaggenwald, 1.622 and 25-30°, Německá Lhota, 1.621 and small; zeunerite, Joachimsthal, 1.612 and 20°. E. F. H.

BARITE AND EPIDOTE FROM PÍSEK. B. Ježek and A. Krejčí. *Rozpravy České Akad.*, class 2, **28**, No. 17, 4 pp., 1919; thru *Min. Absts.*, **1**, 292.

Small colorless barite crystals showed the forms *c a b m N d u o* λ χ and (new) (4.4.15) and (1.2.24). Epidote crystals showed *b z n* and (new) (11.0.4).

E. F. H.

THE MINERALS FROM THE VELKÁ SKÁLA, NEAR PISEK. B. Ježek and A. Krejčí. *Rozpravy České Akad.*, class 2, **28**, No. 19, 4 pp., 1919; thru *Min. Absts.*, **1**, 292.

The pegmatite of the Velka skala (Great Rock) contains crystals of beryl, albite, apatite, and pseudomorphs of gigantolite after cordierite. E. F. H.

A SINGLY REFRACTING POTASSIUM ALUMINUM SULFATE OF THE ALUNITE GROUP. E. Ramann and A. Spengel. *Centr. Min. Geol.*, **1919**, 35–38.

This mineral, formed by solfataric processes at Solfataro di Puzzoli near Naples, was finely granular and isotropic and gave Al_2O_3 36.66, K_2O 11.91, SO_3 38.35, H_2O (diff.) 13.08%, or $K_2O.3Al_2O_3.4SO_4. + 6H_2O$. E. F. H.

APHTHITALITE IN A FUMAROLE OF ETNA. G. Ponte. *Rend. accad. Lincei*, **28**, 362–365, 1919; thru *Rev. géol.* **1**(3) 88, 1920.

Soft green hexagonal plates of aphthitalite were found around a fumarole in the lava of 1918. On keeping, they have become blue and crumbly. The composition is Na_2SO_4 58.9, K_2SO_4 38.3, and $CuSO_4$ 2.8%. The mineral is thought to have been formed by the action of H_2SO on alkali chlorides. E. T. W.

HORIZONTALLY BANDED AGATES. RAFAEL ED. LIESEGANG. *Centr. Min. Geol.*, **1919**, 184–188.

A discussion of the physical and chemical conditions under which horizontally banded agates may be produced. E. F. H.

MINERALOGICAL STUDIES ON MATERIAL FROM SJÖGREN'S MINERAL COLLECTION. G. AMINOFF. *Arkiv. Kemi. Min. Geol.*, **7**, No. 17, 1–58, 1919; *thru Min. Abstr.* **1**, 4, 1920.

(a) Natural etch figures on sulfur crystals conform with the symmetry of the holohedral class. (b) Two new forms, (115) and (11.5.2), were found on a stibnite crystal from Japan. (c) Twinned quartz crystals from Sanarka, Urals, show a tabular development parallel to two prism faces and 5 new forms, $(0.11.\overline{11}.2)$, $(\bar{4}.13.\bar{9}.4)$, $(\bar{7}.29.\overline{22}.9)$, $(\bar{2}.11.\bar{9}.2)$, and $(\bar{1}7\bar{6}1)$. (d) Two heartshaped twins of calcite from Egremont, Cumberland are described. (e) The axial ratio of crystals of chessylite from Copper Queen mine, Arizona, gave $a:b:c=0.8561:1:0.8842$; $\beta=87°35'$. Material from Broken Hill, N.S.W. gave $\beta=86°41'$. (f) Manganaxinite from Franklin Furnace, N. J. showed one new $(4\bar{5}4)$ of the 25 forms present. $a:b:c=0.7797:1:0.9764$; $\alpha=91°55'$, $\beta=81°51'$, $\gamma=102°53'$. W. F. H.

THE HATCHETTITE OF THE COALS OF HAINAUT. X. STAINIER. *Bull. soc. belge geol.*, **28**, 123–128 (1914) 1919; thru *Rev. géol.*, **1** (1), 18, 1920.

The occurrence of the hydrocarbon mineral hatchettite in association with siderite is described. E. T. W.

CONTRIBUTIONS TO THE STUDY OF BELGIAN MINERALS. H. BUTTGENBACH. *Ann. soc. geol. Belgique*, **42**, M 93–124, 1919; thru *Rev. géol.*, **1** (3), 74, 1920.

Several Belgian minerals are described crystallographically, including: calamine from Moresnet with the form *f*; gypsum from Corphalie with the form φ; aragonite from Lavoir with the forms *b* and *e*; calcite from Denée; anglesite and barite not previously noted. Apophyllite, new to Belgium, has been found at Quenast, and zonal groupings of hopeite at Moresnet. A complex clay was analyzed; efflorescences in Liege coal mines found to be trona; and fuchsite indentified optically at Salm-Château. E. T. W.

THE CALAMINE OF THE FOSSIL BONES AT BROKEN HILL, RHODESIA. H. BUTTGENBACH. *Ann. soc. geol. Belg., Publ. rel. Congo Belge*, **42**, annexe, C5–14, (1916) 1919; thru *Rev. géol.*, **1** (9), 329, 1920.

The bones are partly transformed into a crust of crystalline calamine, and also into a spongy aggregate of minute crystals of willemite, smithsonite, hopeite, etc. E. T. W.

CONTRIBUTIONS TO THE KNOWLEDGE OF THE TOURMALINE GROUP. K. SCHLOSSMACHER. *Centr. Min. Geol.*, **1919**, 106–121.

Brown and green tourmaline from St. Gothard, and colorless to pale yellow tourmaline from St. Piero Elba were thoroly investigated as to crystallography, indices of refraction, and specific gravity. E. F. H.